Modeling the Fate of New Jersey's Salt Marshes Under Future Sea Level Rise

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Tidal salt marshes are a characteristic landscape feature of New Jersey 's coastal bays, fringing both the back side of the barrier islands, as well as the mainland. Through the process of vertical accretion of sediment and organic matter, the tidal salt marsh surface will rise in relation to sea level, i.e., the marsh can continue to grow 'up' into a rising sea. When sea level rises faster than marsh accretion, tidal marshes are drowned and replaced by unconsolidated shore (i.e., mud or sand flat) and eventually open water. In addition to accreting vertically, salt marshes can also retreat landward through a process of 'creative destruction.' If there is only a gradual rise in elevation, the adjacent uplands will be periodically flooded by rising tidal inundation. The more sensitive upland vegetation will be stressed by the flooding and higher salinity and be replaced by emergent marsh vegetation. However, in some areas, the slope above the coastal marsh is steeper than the marsh surface itself restricting the landward migration process. Development or other 'hard' obstructions (i.e. levees or bulkheads, roadways, causeways, fill) in the upland fringe adjacent to coastal wetlands will further impinge on the landward retreat process, effectively squeezing out the marshes.

We undertook to model those areas of New Jersey's coastal marsh that were vulnerable for conversion to either mud/peat/sand flats (unconsolidated shore) or open water under 1 to 6 feet of sea level rise. The NOAA Coastal Services Center (CSC) provided a potential marsh change GIS map based on SLAMM (Sea Level Affecting Marsh Model) using a 'moderate' level of vertical accretion (4 mm/yr over a 50 yr time frame). Using geospatial analysis software, we also modeled future marsh retreat zones for these same sea level rise scenarios. Those portions of New Jersey's coastal wetland complex that are free to retreat inland as part of the natural landward migration process were mapped and labeled as **unimpeded marsh retreat zones**. Areas where future tidal marsh retreat are blocked by developed uplands, other coastal protection structures or roads were mapped and labeled as **impeded marsh retreat zones**. Tidal marsh areas that are vulnerable to submergence and conversion to unconsolidated shore (i.e., mud/peat/sand flat) or open water under rising sea levels were also included as **marsh conversion: unconsolidated shore** and **marsh conversion: open water**, respectively. The projected future marsh maps were incorporated into the NJFloodMapper.org WEBGIS tool.

Given that NOAA estimates that sea level could rise between 1 and 2.5 feet by 2050, our modeling results suggest that existing tidal salt marsh could decline by between 5 and 9%

(Table 1; Figure 1). While the predicted loss may be balanced by 'new' marsh (i.e., unimpeded marsh retreat zone) it is unclear on the vegetation composition and ecological value of this 'new' marsh in the short term. Our existing analysis was restricted to a 2050 projection; additional modeling would need to be undertaken to predict further into the future towards 2100, where sea level rise levels of between 2.5 and 7 feet are projected. Based on these results, it would be prudent for New Jersey to proactively sustain its coastal salt marshes by reducing marsh shoreline erosion, preserving future marsh landward retreat zones and enhancing vertical accretion rates.

Table 1. Projected change in salt marsh area under different sea level rise scenarios. Note columns highlighted in yellow represent range in expected sea level by 2050.

DESCRIPTION	**Present** (acres)	**1 ft SLR** (acres)	**2 ft SLR** (acres)	**3 ft SLR** (acres)	**4 ft SLR** (acres)	**5 ft SLR** (acres)	**6 ft SLR** (acres)
Tidal marsh	213,984	204,347	204,202	184,301	158,069	140,832	102,803
Unimpeded marsh retreat		16,632	28,221	39,073	50,751	57,325	65,138
Impeded marsh retreat		1,955	2,980	4,764	7,585	10,072	12,984
Marsh conversion: unconsolidated shore		320	326	19,277	43,827	59,281	89,536
Marsh conversion: open water		9,317	9,456	10,406	12,088	13,871	21,645

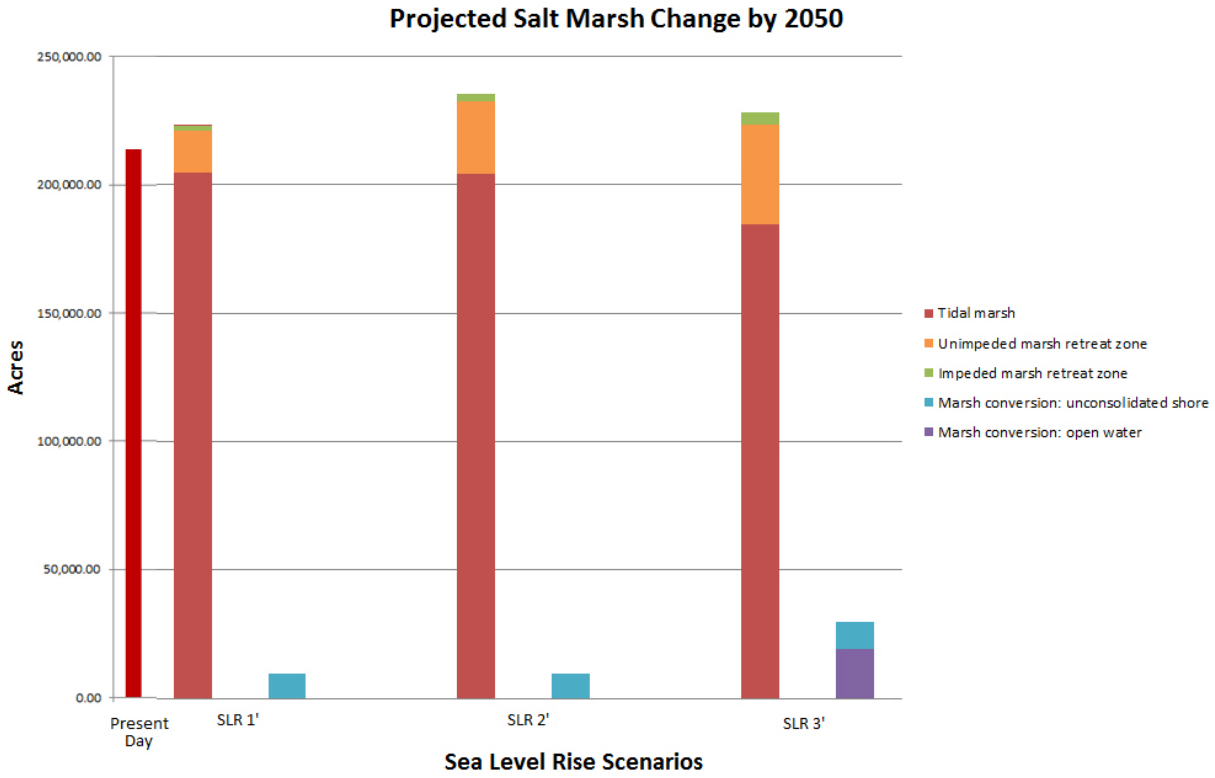

Figure 1. Projected salt marsh changes to 2050.